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A FISHERIES SURVEY OF TWIN LAKE, MARQUETTE COUNTY

by

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Twin Lake, sometimes referred to as Witch Lake Twin, is located in Republic Township (T. 45 N., R. 30 W., Sec. 23, 26). It lies to the south of Fence River road about one mile west of Witch Lake proper. From Republic, the nearest town, it is reached via a good road (M-95) to Witch Lake village, thence west on Fence River road about 3/4 of a mile.

During the period August 5-7, 1940 this lake was inventoried by a survey party* of the Institute for Fisheries Research. The map used in this report was made at the time of the survey. Interest in this body of water has never been great, but the apparent suitability of it for trout resulted in its inclusion in a list of lakes to be surveyed compiled by Mr. Louis Sauheitl, supervisor of the Marquette Fish Hatchery. Some assistance was given the survey party by Mr. Sauheitl and Mr. Edward Morris. Apparently, Twin Lake is fished very little and the history of its fishery is rather vague. It is reported that, although brook trout have been taken in very limited numbers

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*The survey party consisted of Fred E. Locke, leader; Burton P. Hunt, Irving J. Cantrall and Pat Galvin, assistants.

from this lake, some very good catches of perch have been secured. However, from general information concerning this lake, it appears that fishing is quite poor and that the lake is frequented by only a few anglers each year. Two cottages are near the lake and about three-fourths of the frontage is privately owned. The remainder is owned by the state.

Twin Lake lies in a morainic basin which was probably formed by the melting of a large ice block left imbedded in the moraine when the glacier retreated from that area. Steep, wooded hills surround the basin; hence, drainage into the lake is quite limited. Although this lake lies within the Michigamme River drainage, it has no direct connection to this system except at times of high water. The lake level fluctuates about 1-1.5 feet annually. When the level is high, Twin Lake overflows to the south into Hogan Lake (reported to be a private lake), which occupies the same basin and is separated from Twin by a low bank of swampy land. From Hogan Lake the waters pass down a small outlet which joins a stream from Witch Lake. This stream flows into the Michigamme River. The immediate shore of Twin Lake is encroaching. However, the mat formation is not extensive. Many fallen trees extend into the lake and form considerable natural cover.

Twin Lake has an area of 21.9 acres and a maximum depth of 90 feet. The basin is quite regular, sloping rather steeply (an average grade of about 12 per cent) toward the deepest point, which is slightly west of the lake's center. The south portion of the lake, which forms a broad bay, is more shoal than the remainder. Along the northwest side, the bottom gradient is over 20 per cent. Only 10.8 per cent of the lake's area is between the 0.0 and 10 foot contour lines. The bottom types on these rather limited shoals are generally sand, rubble and gravel. Some fibrous peat occurs where shore

encroachment is progressing. Pulpy peat is the sole bottom type below the 15-foot contour. Water in this lake is colorless and quite clear. A Secchi disc disappears from view at a depth of 15.5 feet. The lake water is derived from seepage and run-off.

The physical features of Twin Lake as cited above are indicative of low productive potential. Enrichment of the water from terrestrial sources is limited by the small drainage area and the rather poor condition of the surrounding soils. The ratio of shoal to deep water is very low and, consequently, the productive volume of the water and the area of productive shoal are limited. Regularity and steep gradients of the basin restrict bays and protected water environments which are usually the most productive portions of a lake. Shoals of gravel and rubble are fairly good environments for bottom foods utilized by fish, but the encroaching nature of most of the shore line counteracts some of this production. Steep slopes of the lake bottom limit the area in which aquatic plants will grow, because they descend so rapidly that they soon pass the depth to which effective light will penetrate. Clarity of the waters of Twin Lake extends this effective light range somewhat, but not enough to offset the restriction of plant beds by the steep bottom slopes. This water transparency also indicates that the organic content and plankton (minute organisms living free in the water) crop of Twin Lake are poor.

The thermal and chemical conditions of Twin Lake as found by the survey party are given in Table 1. These data were taken August 7, 1940, at 11 a.m., when the air temperature was 75° F. Since July and early August are probably the warmest periods of the year in this region, the results obtained from Twin Lake are near the summer thermal maximum for this lake. Consequently, the data are valuable in determining which species of fish are best suited to the lake, as far as water temperature and chemistry are concerned. It should be noted from the table that the waters of Twin Lake were stratified and that

the thermocline (the zone of rapidly decreasing temperatures) began about 12 feet below the surface and continued to a depth of 30 feet. In the surface layers (0-12 ft.), the temperature was remarkably low for early August. Conditions of dissolved oxygen, which is necessary in concentrations of 3-4 parts per million or more to maintain fish life, were good (8.0-8.15 p.p.m.). The thermocline layer (12-30 ft.) had a temperature range of 26° F. (72.6° to 46.6° F.). The concentration of dissolved oxygen in this layer was higher than that in the surface waters. Below the thermocline, water temperatures decreased gradually until at a depth of 54 feet they became constant at 40.6° Fahrenheit. Only a trace of oxygen was found near the bottom of Twin Lake. Carbon dioxide, present at the surface, increased somewhat in the thermocline and reached a concentration of 13.5 p.p.m. at the bottom of the lake. The water of this lake was found to be on the acid side according to pH tests. These are tests to determine the acidity or alkalinity of a body of water. The pH ranged from 6.8, nearly neutral, at the surface to 5.6, quite highly acid, at the bottom. Especially noteworthy is the relative softness of the water, as is shown by the methyl orange alkalinity tests. Only five parts per million of salts with the same reaction as calcium bicarbonate (lime in solution) were present.

These thermal and chemical findings indicate that the productivity of Twin Lake is quite limited. Low water temperatures inhibit luxuriant growth of plants, bottom foods and warm water fish. This condition is aggravated by the geographical position of this and other lakes of the region. The growing season in waters at such latitudes is very short, at most three to four months long. In a lake with low temperatures, this growing season is further shortened, especially for those fish requiring warmer waters for their best growth.

Table 1

Thermal and Chemical Conditions of the Water in Twin Lake, Marquette County, August 7, 1940

Depth in feet	Temp. in °F.	Oxygen in p.p.m.	Carbon dioxide in p.p.m.	Methyl orange alkalinity in p.p.m. of $CaCO_3$	pH
Surface	74.1	8.15	1.0	5.0	6.8
3	73.7	..	...	...	...
6	73.7	..	...	...	...
9	72.9	..	...	...	...
12	72.6	8.00	1.0	5.0	6.8
15	69.8	..	...	...	...
18	63.0	..	...	...	...
21	57.2	..	...	...	...
24	52.8	..	...	...	...
27	49.1	10.50	3.0	5.0	6.2
30	46.6	..	...	...	...
33	45.0	..	...	...	...
36	44.2	..	...	...	...
39	43.2	..	...	...	...
42	42.0	..	...	...	...
45	41.5	..	...	...	...
48	41.2	..	...	...	...
51	41.0	..	...	...	...
54	40.6	..	...	...	...
57	40.6	..	...	...	...
60	40.6	..	...	...	...
63	40.6	..	...	...	....
66	40.6	..	...	...	...
69	40.6	..	...	...	...
72	40.6	..	...	...	...
75	40.6	..	...	...	...
78	40.6	..	...	...	...
81	40.6	..	...	...	...
84	40.6	..	...	...	...
87	40.6	0.50	13.5	5.0	5.6
90	40.6	..	...	...	...

Occurrence of oxygen in the thermocline and waters below it to considerable depths indicates a paucity of oxidizable organic matter in the water. This organic matter is the basic food of bacteria, plankton (small microscopic, free-floating plants and animals) and some of the bottom inhabitants. Organisms which utilize this plankton as food are generally eaten by fish.

Some fish eat the plankton directly. Acidity of water is generally considered restrictive to luxuriant plant and animal growth. Only certain species are able to tolerate such conditions. The softness of the water in Twin Lake is one of the important factors limiting production. Calcium, potassium, magnesium and sodium salts are necessary in the physiology of plants and animals. When present in sufficient quantities, these metallic salts foster good plant, plankton and fish food production. Softness of water is generally due to a paucity of these salts, especially calcium and magnesium. In addition to being necessary in the life of a lake, some of these salts condition the acidity of the water by taking the acidifying agents into chemical union, thus temporarily removing their action from the water. Calcium salts are absolutely necessary for any of the snails, clams, and to a certain extent, for insects and other fish foods with a hard, chitinous body. Furthermore, the skeletal structures of fish are composed almost entirely of calcium salts. This material must be derived from food eaten.

Plants in Twin Lake are limited to three different kinds. Narrow beds of yellow water lily (Nuphar variegatum) occur spottedly around the shore. Some beds of quillwort (Isoetes Braunii) are located between depths of 1-6 feet. The moss, Fontinalis, blankets the bottom between depths of 20-36 feet. Otherwise, plants are lacking with the exception of that assemblage of semi-aquatic forms which constitute the encroaching shore mats. The plants in Twin Lake are not too good as harborers of aquatic life. Fontinalis moss was found to offer shelter and abode to rather large populations of midge larvae. Other species are not leafy enough to be good shelters for food; however, they do provide some cover for fish. Although the plants in this lake are definitely

inadequate, it is believed that a maximum plant growth occurs there. Any increase of plants is limited by the steep basin and acid water conditions.

Plankton (small, free-swimming, microscopic plants and animals) was not too abundant at the time of the survey. An average of 5.0 cc. per cubic meter was found. Predominant in this population were animal forms. Compared with other lakes of this region, this plankton crop is below average for this time of year. However, not much information about annual plankton production can be derived from one sampling period. Plankton populations fluctuate quite rapidly.

Bottom organisms were found to be rather limited on the shoals of this lake. Predominant were midge larvae (Chironomidae) and aquatic earthworms. A few mayfly and dragonfly nymphs were noted. Areas of the bottom between water depths of 20-36 ft. were covered with moss (Fontinalis), and midge larvae occurred there in considerable numbers. The deep portion of the lake (36-90 ft.) was practically devoid of any bottom fauna. Occasional midge larvae were taken in the shallower waters (36-50 ft.), but nothing could be found at greater depths.

Game fish taken or reported from Twin Lake were brook trout, yellow perch and largemouth bass. Perch were the most abundant. Largemouth bass were common and but one brook trout was taken. Young of perch and bass were seen, but no trout fry or fingerlings were present. This population of game fish was somewhat scarce. No great abundance of any species was found. Only one species of forage fish was taken. Golden shiners were common in the lake, being most abundant in areas of dense brush cover.

Conservation Department stocking records show no fish plants made in Twin Lake during the years 1934-1939 inclusive. Some very vague reports from

local residents have it that brook trout were once stocked. Credence is given this report since these trout occurred in the lake. Natural stocking may have been possible, but is quite unlikely. The lake has no inlet and only an intermittent outlet into Hogan Lake.

Scale and growth rate studies of the fish taken from Twin Lake, although based on meager data, seem to show that the fish grow rather slowly. Perch reach a legal length sometime during their fifth summer of life. They averaged 5.5 inches total length late in their fourth year. Weights of these fish were only average. One perch, 10.6 inches long and in its seventh summer, weighed only 6.7 ounces, which is about two ounces below average. The only largemouth bass taken was in its third summer. It was 13 inches long and weighed 20 ounces. If this one specimen is representative of the bass population, these fish grow phenomenally fast. However, it is believed that a study of a large series of bass would reduce this growth rate considerably, since it is known that rapidly growing cannibals occur in most every bass brood. These individual fish far outgrow the general population. One brook trout, the only other game fish taken, was in its fifth summer. It was 13.7 inches long and weighed 18.3 ounces. Here again, no series of these fish was available for study and the one specimen probably does not express the true average growth rate for this species.

Spawning facilities are ample for perch and largemouth bass, considering the limited food supply. Much better growth in both of these species will be obtained if the population is kept low enough to make the limited food supply adequate. Trout, if they are to be maintained in the lake, will have to be stocked periodically as there are no known spawning grounds available for them.

The biological studies, reported above, substantiate the statements made concerning low productivity in Twin Lake. Plants, plankton and bottom foods

are not very plentiful. Their abundance is conditioned by the physical and chemical attributes already described. As a result of the lowered food supply, fish in Twin Lake are, in most instances, scarce and slow-growing. However, all species of fish are not equally capable of successful living in a given body of water. Some fish require different water temperatures and oxygen concentrations than others. Some species have a lower reproductive rate than others, and, consequently, do not overpopulate a body of water as fast. For these species a given food supply would be adequate longer than for those with a high reproductive rate. In waters like Twin Lake, where conditions are suitable for the maintenance of cold water species of fish and are not so near the optimum for the warm water species, encouragement of a trout population seems the logical action. Furthermore, these fish, in most instances, do not spawn in lakes, which makes control of the population comparatively easy, since all additions of trout to this lake will be from artificially reared stock.

RECOMMENDATIONS

1. Twin Lake is classified in the "all others" group. There is no reason why the designation of this lake should be changed, unless the following management suggestions are followed. In the latter case, it would be necessary to change the lake's designation to "trout lake" status.

2. No warm water fish should be stocked in this lake if it is left in the "all others" group. Natural reproduction is more than sufficient to maintain a population equal to the available food supply even under heavier fishing pressure than now exists there. Stocking of these species will only tend to crowd the lake and cause stunting in the various species, especially perch. This stunting appears to be in its initial stages, considering the growth rate of the perch from Twin Lake.

3. Predators are not abundant enough on or in this water to necessitate any methods of control. Parasites were not abundant. However, the one brook trout taken was infected with gill lice. This certain species of gill parasite (Copepoda) is specific to the brook trout. Its elimination is quite necessary if the lake is to be stocked with additional trout of this sort.

4. Natural cover is abundant enough in Twin Lake to offer sanctuary to fish of all species now present. Deadheads, brush and encroaching bog mats constitute the cover and the entire shore line is lined with these materials. Due to the nature of the lake basin, installation of brush shelters on the rather precipitous bottom in the deeper portions of the lake would be quite difficult. Furthermore, the effect of such shelters would not be necessary, since hiding places for fish are already ample. Vegetation, as cover, is almost lacking. A few beds of emergent plants occur around the shore. The formation of encroaching shore is largely due to plant growth. These encroachments afford considerable cover in shallow water.

5. The water level in Twin Lake fluctuates with the seasons, but is not great enough to seriously affect the lake's biology. However, in spring, when the level rises due to run-off, an intermittent connection with Hogan Lake to the south is established. If Twin Lake is to be converted to a trout lake, some method of control of this outlet must be established in order to stop immigration of undesirable and competitive species of fish from Hogan Lake. Diking of the lowland between the two lakes and construction of a control dam is suggested. This dam should have a slat apron on it through which water falling over the dam might pass and which would frustrate any jumping attempts on the part of migrating fish. Downstream migrants could be withheld by a coarse screen above the dam, if this were found necessary.

Brush or rock filter dams for this purpose have been suggested in Bulletin No. 2, but have not been thoroughly tested. This lake might be used to test the efficiency of one or the other of these types, if the program as recommended is carried out.

6. Complete removal of the present fish population by poisoning is recommended, in July, 1941, followed after three months by a planting of 12,000 rainbow trout fingerlings (approximately 600 to the acre, as recommended by Shetter in Report 620). Annual stocking with this number of rainbow fingerlings for the next six years is urged. The fish should be of the same size and age, and from the same source of eggs in so far as this is possible.

7. A complete record of the catch for a six-year period starting in 1942 should be kept, if it appears from investigations following stocking that the trout will reach legal size during this year. If not, the lake should be closed to angling during the season of 1942 and the creel census started in 1943.

8. Starting in the spring of 1945, fertilizer in the form of crushed limestone and soy bean meal should be applied each year for a three-year period, at the rate of 100 pounds per acre of each of these fertilizers.

9. Careful analyses of the water for carbonates, nitrates and phosphates, etc., should be made before and after fertilization, and an accurate comparison of growth, condition, feeding habits and yield of trout should be made through records from creel census. The necessary collections, exclusive of chemical analyses, can be taken by the creel census clerk.

10. In case the property owners object too strongly to the proposed experiment, especially to the prospect of the lake being closed for a year, 300 tagged, legal-sized rainbow trout (7-10 inches) and 6,000 fingerling rainbows should be planted in the fall of 1941. Thereafter, 12,000 fingerling rainbows should be planted annually as recommended above.

INSTITUTE FOR FISHERIES RESEARCH

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INSTITUTE FOR FISHERIES RESEARCH

DIVISION OF FISHERIES MICHIGAN CONSERVATION DEPT.

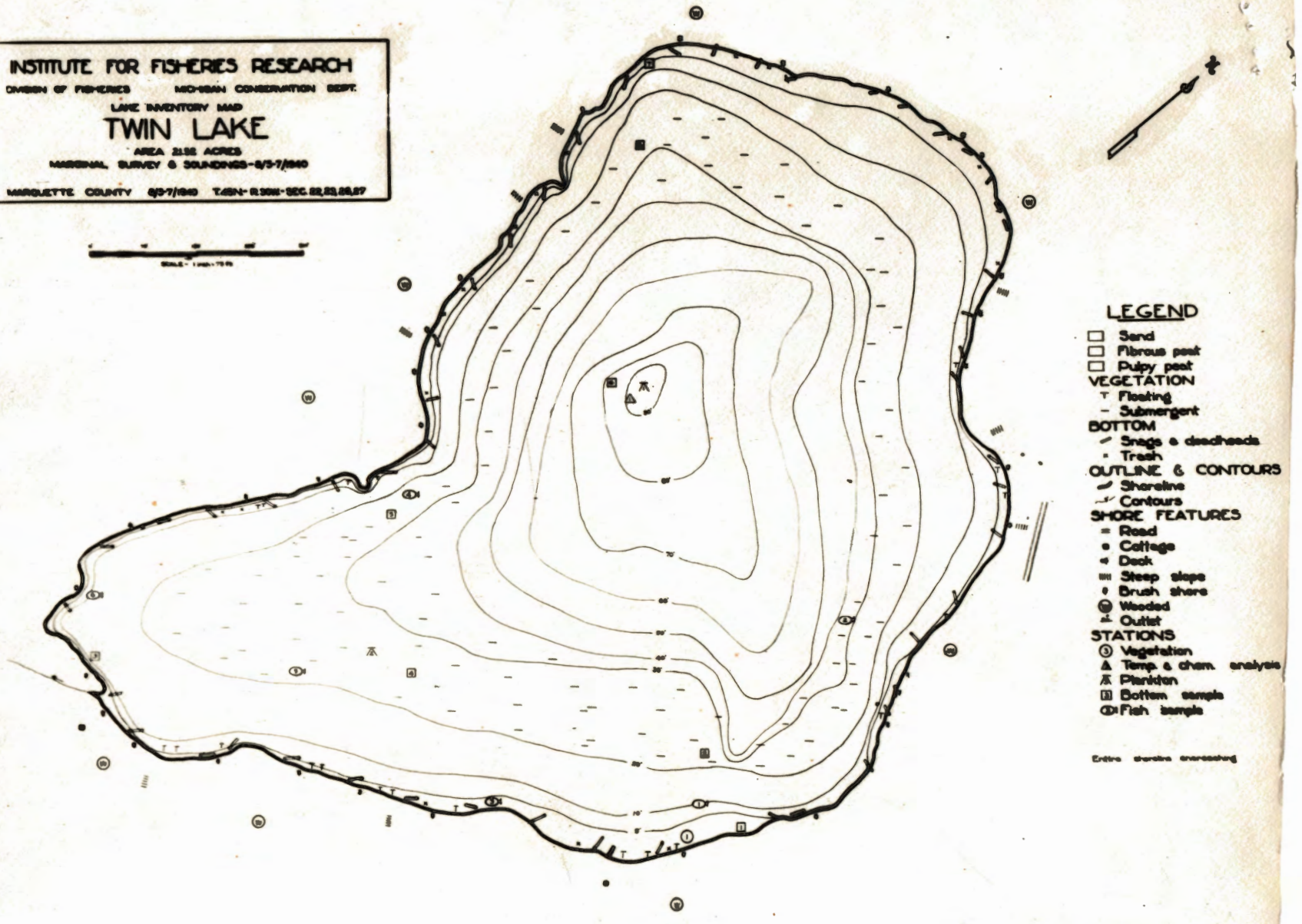
LAKE INVENTORY MAP

TWIN LAKE

AREA 21.55 ACRES

MARGINAL SURVEY & SOUNDINGS-6/3-7/1940

MARQUETTE COUNTY 6/3-7/1940 T.45N- R.30W- SEC. 22,23,26,27



LEGEND

- Sand
- Fibrous peat
- Pulpy peat

VEGETATION
- Floating
- Submergent

BOTTOM
- Snags & deadheads
- Trash

OUTLINE & CONTOURS
- Shoreline
- Contours

SHORE FEATURES
- Road
- Cottage
- Dock
- Steep slope
- Brush shore
- Wooded
- Outlet

STATIONS
- Vegetation
- Temp. & chem. analysis
- Plankton
- Bottom sample
- Fish sample

Entire shoreline overgrazed